Applying Process Mining in Blockchain Transactions

Massimiliano Sampaolo

January 23, 2019

Supervisor: Barbara Re
Second supervisor: Andrea Morichetta

Objective and Motivations

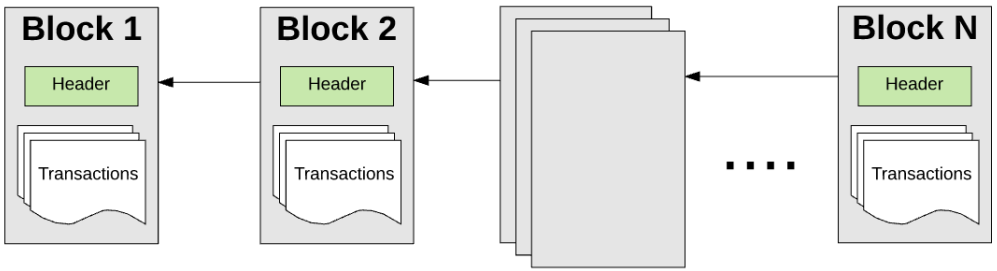
The thesis want to understand and define bindings between **blockchain** transactions using **process mining**.

Why?

- Blockchain and process mining are hot topics in industry and academia
- Infer and analyse the behaviour of systems to increase their quality
- Give a graphical representation of processes defined by software systems

Blockchain

Chain of blocks:



Blockchain characteristics:

- Decentralization
- Trasparency
- Security
- Immutability

Ethereum: EVM, Smart Contracts and DAPP

Process Mining

A **Business Process** is a collection of related and structured activities undertaken by one or more organisations in order to pursue some particular goal.

Process mining has the goal to discover, monitor and improve real processes by extracting knowledge from event logs readily available in today's information systems.

Three form of process mining:

- Process discovery
- Conformance checking
- Enhancement

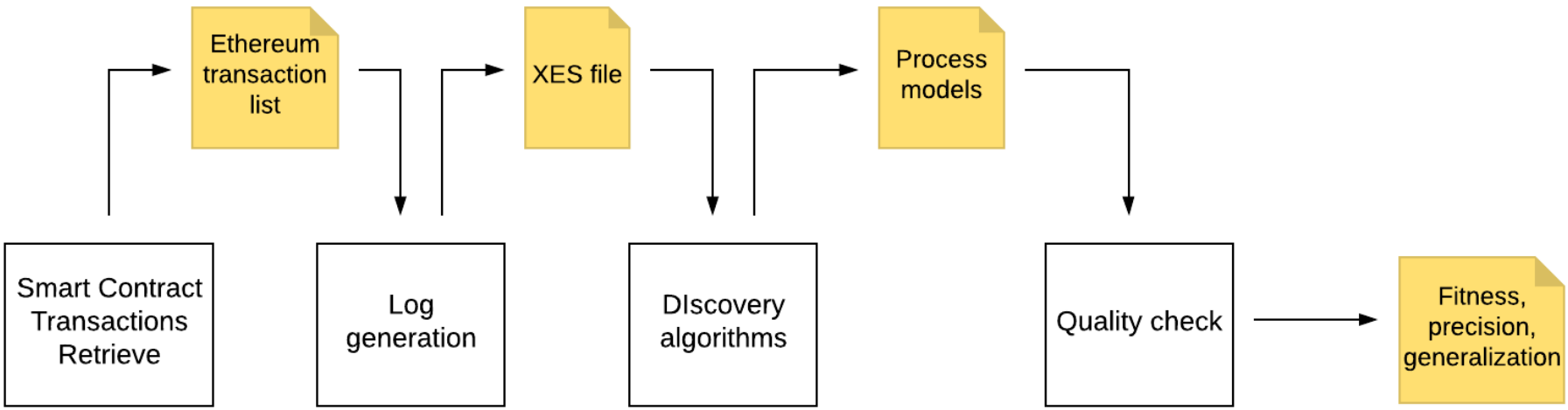
Discovery algorithms

Used discovery algorithms:

- **Heuristic Miner**, it builds a Directly Follow Graph, filters noise based on ordering relationship frequence
- **Inductive Miner**, it uses a divide-et-conquer approach, first it creates a DFG then it filter infrequent dependencies and after that it applies cuts to the graph recursively
- **Split Miner**, produces a BPMN model in five steps:

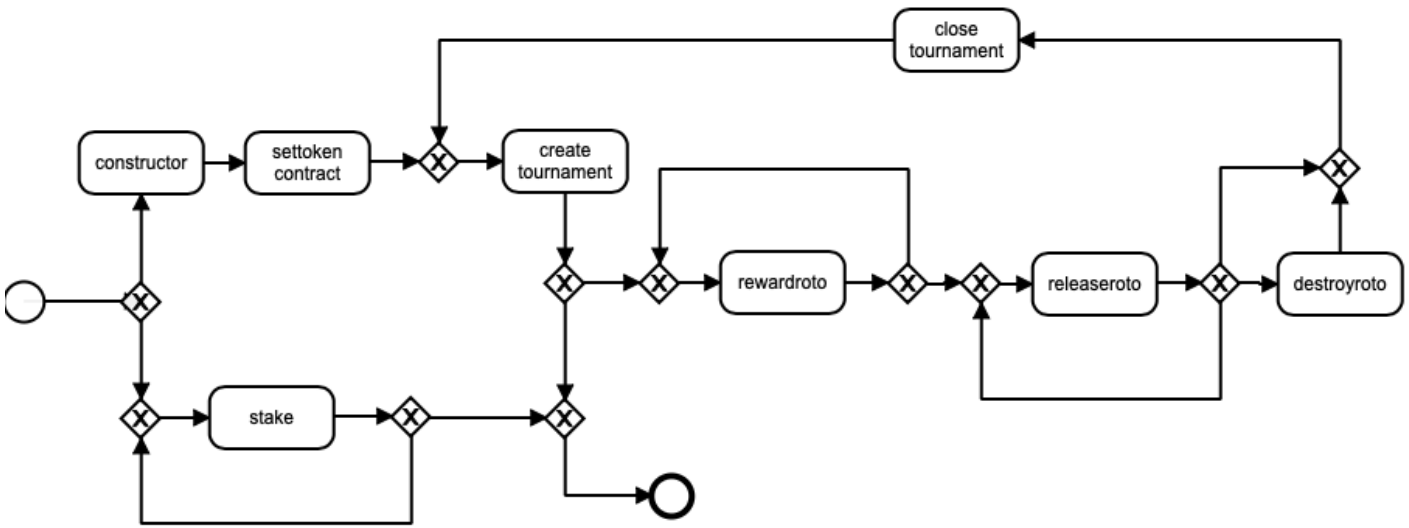
Case Studies

The methodology used for the case studies consists of several steps:



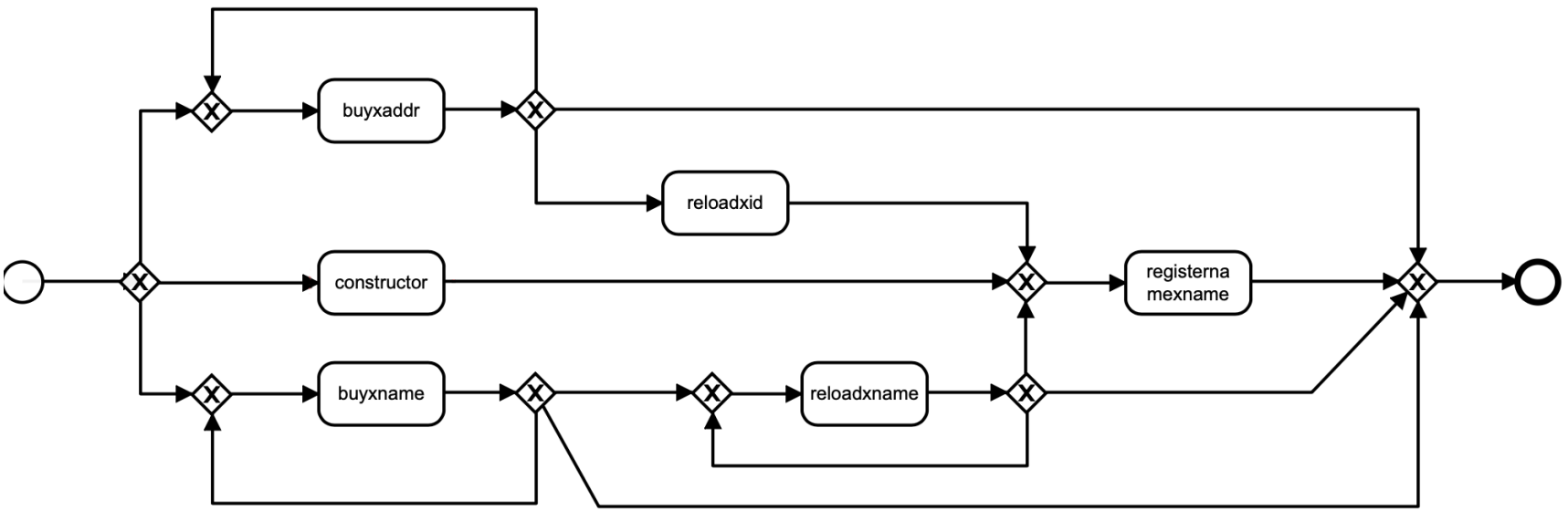
RoToHive

RotoHive is a new type of fantasy sports site that runs weekly tournaments.
Model discovered with Heuristic Miner (the best algorithm in this case):



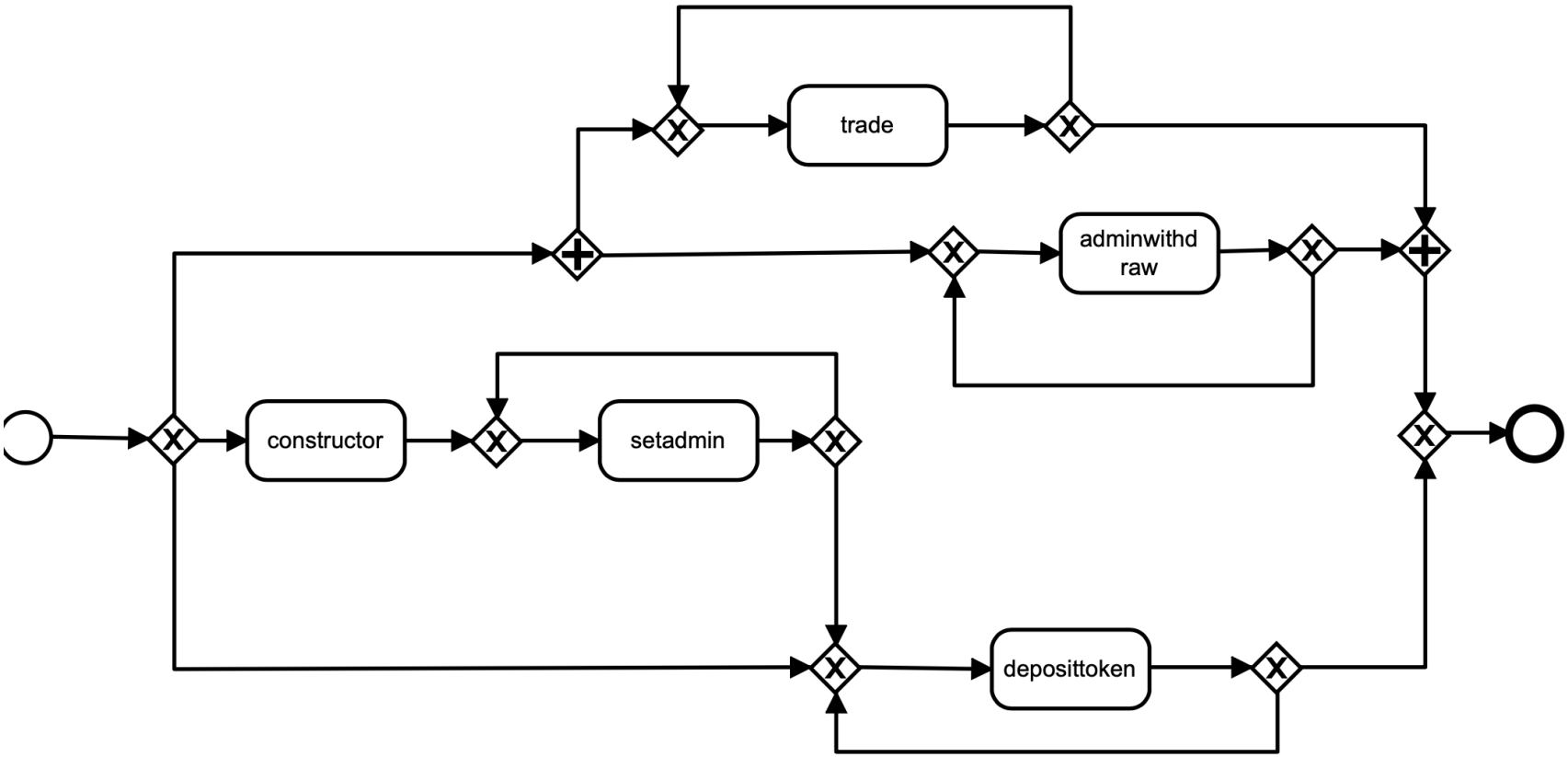
Fomo 3D

This is a lottery game in which the last person to buy a key at the end of a round wins the jackpot!
In this case, Split and Inductive Miner discovered the same model, better than Heuristic Miner one.



IDEX

IDEX is a cryptocurrency exchange. Exchanges are applications that allows the user to deposit, withdraw or exchange cryptocurrencies.



Quality measures

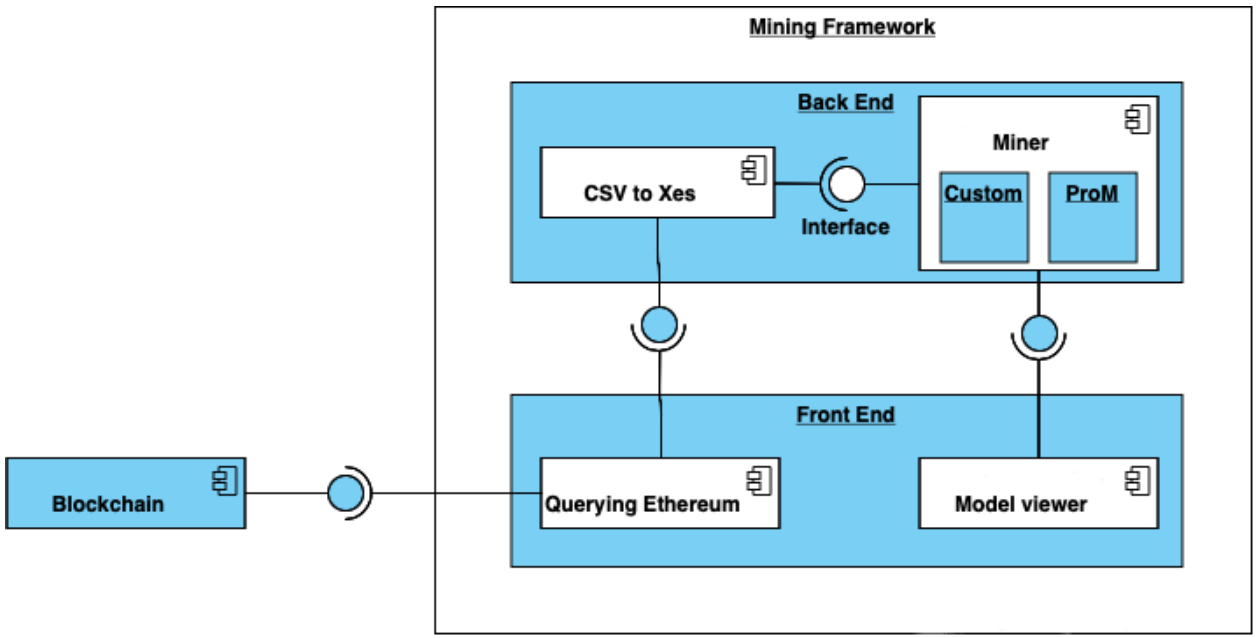
Quality measures obtained in the case studies with the three used algoritms:

	Fitness			**Precision**			**Generalization**		
Algorithm	Roto	Fomo	IDEX	Roto	Fomo	IDEX	Roto	Fomo	IDEX
Split	1	0.97357	0.99573	0.20453	0.47947	0.22884	0.99892	0.96836	0.99914
Inductive	0.99995	0.97357	0.99971	0.60294	0.47947	0.48298	0.99496	0.96836	0.99968
Heuristic	0.99940	0.98710	1	0.49889	0.48634	0.32516	0.99889	0.87593	0.99882

Design and implementation

The system designed recreates the methodology used in the case studies analysis.

The architecture of the Mining Framework:



Lessons learned

Sound models discovered and pretty good quality parameters measured.

The three algorithms obtained similiar results. How well an algorithm fits a specific application domain depends from the domain itself regardless the fact that it uses the Blockchain.

The analysis infer the logic of the system. Can be used to increase solution quality, or understand how users interact with a product.

Thanks for your attention!